

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION 8



POLREP 1

REMOVAL SITE EVALUATION

Subject: Red and Bonita Mine Site

To: Laura Williams, Response Unit Chief  
David Ostrander, Program Director

From: Steve Way, On-Scene Coordinator

Date: March 30, 2013

Reporting Period: August 2010 to December 2012



## **1.0 INTRODUCTION**

### **1.1 Background**

The Red and Bonita Mine is located within the Cement Creek watershed, a component of the upper Animas River watershed in San Juan County, Colorado. These watersheds within the volcanic terrain of the San Juan Mountains were the focus of both large and smallscale mining operations that flourished beginning in 1871 and lasted until as late as 1991. Historic mapping of the Red and Bonita Mine indicates that it was advanced predominantly prior to 1899. Mining operations lasted a short period, but no activity occurred after the initial operations. Several other mines in the Cement Creek basin also have draining adits. The flow from the Red and Bonita Mine, the Gold King (Level 7) Mine, and the Mogul Mine all experienced significant increases in flow following the plugging of the American Tunnel that occurred between 1998 and 2002. Water quality in the Animas River has been degraded progressively since that time.

The Animas River and many of its tributaries, including Cement Creek, carry high concentrations of metals from both acid rock/mine drainage at mine sites and from natural sources not impacted by mining. Water quality studies have indicated that the Red and Bonita Mine is one of the major sources of metals to the Animas River near Silverton. The EPA, BLM and USGS have undertaken activities to more fully quantify the various mine site sources and to quantify diffuse metals sources within the mine district that contribute to the metals loads in the Animas River. These actions are intended to contribute to the information needed to identify potential remedies to reduce or prevent the on-going hazardous substance (metals) releases from the mine sites.

### **1.2 Site Description**

The Red and Bonita Mine consists of approximately 1.25 acres of waste rock and suspected tailings material, and an estimated 3,000 foot long adit that drains approximately 300 gallons per minute throughout the year. The mine water discharge occurred through a collapsed rock debris blockage for an unknown number of years. A new portal structure was installed in October 2011 after removing 30 feet of blockage at the adit entrance. Adit discharge flows overland across, and approximately 200 feet down, a mine dump face before being channelized at the toe of the dump. The channel directs flow into an iron bog en route to Cement Creek approximately 500 feet down gradient of the toe of the dump. The mine site lies on a west-facing mountainside slope with an

average 44 percent grade, east of Cement Creek. The mine is accessible during non-snow months of the year, typically late June through early October. The mining claims associated with this mine are on steep terrain and create limiting conditions for operations. The site elevation is approximately 10,800 feet and is seasonally inaccessible due to snow and extreme weather conditions.

### **1.3 Location**

The Red and Bonita Mine Site is located in San Juan County, Colorado. The portal is approximately 7 miles north of the town of Silverton, Colorado, at 10,893 feet above mean sea level (AMSL) at 37 degrees 53'49.95"N and 107 degrees 38'38.70"W. Road access is via County Road (CR) 110 from the town of Silverton to CR53 at the abandoned town site of Gladstone. CR53 continues northward up the Cement Creek valley to the mine site, approximately 0.5 mile north of Gladstone.

### **1.4 Description of Threat**

Since 2005, adit discharge rates have been observed to be increasing from approximately 200 to 300 gpm. The pH of discharge water typically averages 6.1 standard units (su). More recently, since August 2012, the pH has dropped to approximately 4 su. The adit discharge water contains high concentrations of several metals that include (and their approximate concentrations measured over many years): total aluminum (4,000 parts per billion (ppb)), cadmium (35 ppb), iron (90,000 ppb), lead (60 ppb), manganese (34,000 ppb), and zinc (16,000 ppb). The discharge from the adit represents a significant release of the heavy metals including zinc to the Animas River

The results of a Screening Level Ecological Risk Assessment (February 2013) strongly suggested that the fish community in the Animas River at and below Silverton would experience high stress under current conditions. For example, the surface water hazard quotient for zinc in the Animas River below the confluence with Cement Creek is approximately 4, which is four times the expected no-effects level. In addition, the study identified Al, Cu, Pb, and Zn as the major risk drivers to insectivorous birds ingesting surface water, sediment, and aquatic invertebrates from the Animas River at and below Silverton. Also, the metal concentrations measured in the substrate of the Animas River at and below Silverton were expected to be highly toxic to benthic invertebrates. Recent fish

population studies conducted by the Colorado Division of Wildlife found no fish in the Animas River below Cement Creek for approximately 2 miles.

### **1.5 Preliminary Removal Assessment / Removal Site Inspection Results**

Initial removal assessment investigations of the Red and Bonita Mine in 2010 were focused on both the discharge from the collapsed adit and determining if a significant contribution of metals to the discharge occurred as water flowed over and through the waste dump. The investigation findings showed that there was relatively little addition of metals to the adit discharge water from the waste dump. Mine water drainage flows from the adit over the mine dump face at the typical rate of approximately 300 gpm into Cement Creek. The Cement Creek confluence with the Animas River is approximately 7 miles downstream at the town site of Silverton.

As part of the evaluation of the adit discharge at the Red and Bonita, base line information regarding flows and water chemistry were collected at three other mine discharges in the basin: Mogul Mine, Gold King (level 7) Mine and the American Tunnel. This information will be used in an attempt to determine if hydraulic connections and water chemistry similarities exist. In addition, this information will be critical to predicting or measuring changes in flow and water quality in the other mine discharges if engineered hydraulic controls are implemented in the Red and Bonita Mine. Flow measurements were made at the four adit drainages to develop a base line of comparable flow data. Although continuous measurements were attempted using pressure transducers/data loggers, this was not successful due to iron fouling of the probes while sitting in the water and due to animal (marmot) activity in the flumes. Manual flow measurements were collected using fixed and portable flumes.

In 2010 EPA also initiated an investigation to determine the extent of blockage in the adit. As part of that effort, a bore hole was drilled approximately 30 feet beyond the face of the hillside slope and adit opening, and it was determined to drill into the void of the adit/tunnel. At that location a monitoring well, used to monitor the impounded water within the adit, was installed, to determine if the adit blockage was under hydraulic pressure from a possible mine pool. This was necessary to determine before the removal of the collapsed portal in 2011. It was necessary to remove the blockage to allow future entry to assess the hydrogeologic and geotechnical conditions in the adit. In addition, a future blowout of the blockage was a potential risk if the debris had not been removed. During removal of the collapsed rock debris at the portal a large volume of water was pumped (multiple times) from the adit in order to control both the pressure

against the soil/rock mass and to prevent the turbid water from releasing. All disturbed water pumped during portal excavation and later during mine entry activities received a flocculent and/or was filtered prior to release into Cement Creek. A new mine portal was installed in October 2011.



New mine portal, 2011

The waste rock dump at the Red and Bonita Mine contains an estimated 3,962 cubic yards in a two tiered pile. Tier 1 constitutes the majority of the waste rock at the site and represents all waste material observed above a bench, or abandoned access road, located mid-way up the mine dump. Tier 2 represents all waste material observed between the main county access road and Tier 1. Volumetric calculations are estimates.

| <b>Red and Bonita Waste Rock Pile</b> | <b>Area<br/>(feet<sup>2</sup>)</b> | <b>Volume<br/>(yards<sup>3</sup>)</b> |
|---------------------------------------|------------------------------------|---------------------------------------|
| Tier 1                                | 22,321                             | 3,160                                 |
| Tier 2                                | 23,099                             | 802                                   |

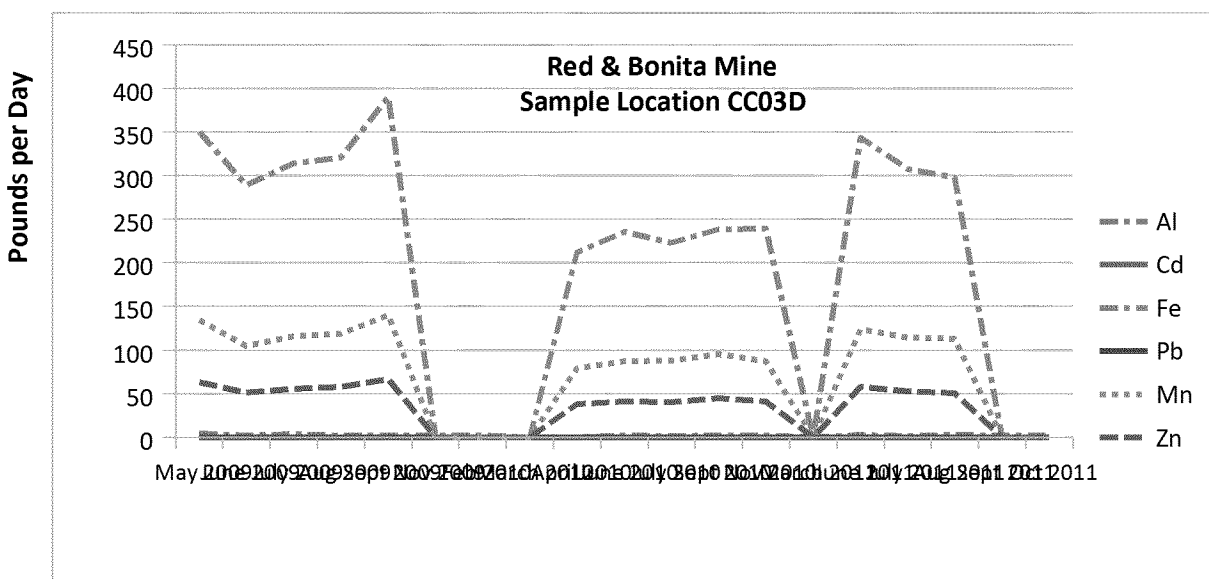
Based on an estimate using 2010 data, the Red and Bonita adit contributed approximately 18 to 16 percent of the zinc load, during low to medium flow respectively, to Cement Creek at the confluence with the Animas River. Among the four primary adits in upper Cement Creek, the Red and Bonita represents up to 33 percent of the zinc source, and the adits represent up to 56 percent of the zinc load in Cement Creek. The adit drainages from Cement Creek make up an estimated 37 percent of the zinc load entering the Animas River as measured at location A72 below Silverton.

Dispersed sources (groundwater and surface flow) make up the balance. Mercury has not been observed within non-disturbed mine discharge water, but mercury is present in the precipitated solids inside the mine as evidenced by the 0.667 ppb detected in the mine drainage during a mine entry. It again decreased to non-detect at the portal discharge following entry work. Mercury was not detected at the town site of Gladstone, approximately 1 mile below the mine site, at the time of mine entry activities.

**Mine Adit Discharge 2005 to 2011**

| Mine              | Elevation<br>(feet AMSL) | Bulkhead<br>Install | Flow Rate (gpm) |                   |                 |                 |                 |
|-------------------|--------------------------|---------------------|-----------------|-------------------|-----------------|-----------------|-----------------|
|                   |                          |                     | July<br>2005    | September<br>2005 | October<br>2006 | Average<br>2010 | Average<br>2011 |
| Red and<br>Bonita | 10,893                   | None                | 210             | 224               | 233             | 216             | 319             |

gpm – Gallons per minute. AMSL – Above mean sea level.



CC03D located at toe of mine dump in channelized mine discharge flow.

## 2.0 SITE OPERATIONS

### 2.1 Current Assessment Activities

The mine adit is approximately 6 feet by 6 feet and extends underground for an undetermined length; based on historic information and the estimated waste dump volumes it is estimated to be

approximately 3,000 feet in length. The first 680 feet has been verified to be open without blockages/collapses and to be within a competent andesitic rock requiring little to no support. The portal structure was built into a ferricrete mass entering the adit, also mostly competent.

The entry performed in June 2012 was performed to evaluate the rock structure and water sources entering the workings for purpose of evaluating the potential for implementing hydraulic controls. The underground assessment work was performed by a team including mining engineers and a geologist with the Colorado Division of Mining, Reclamation, Mining, and Safety (DRMS), supported by EPA. Underground investigations revealed an abundant accumulation of yellowboy to the 680 foot distance that was investigated. An inflow approximately 10 gpm was observed from a small drift located at approximately 283 feet inby, while the remainder of the approximate 300 gpm flow was from beyond 680 feet inby. The entry was terminated because yellowboy solids that were disturbed by the entry team and crews placing air bag caused the water filtration system to reach its maximum capacity to filter the suspended solids.

The mine adit contains yellowboy accumulations varying in thickness from 0.5 to 3 feet to at least 680 feet inby, which was the maximum extent of the investigation in June 2012. The extent and depth of the precipitate, contributes to waist-deep mine drainage water in some areas, rendering mine entries very difficult. Air inside the adit is oxygen depleted and required active ventilation to allow for safe entry by personnel going beyond the initial 50 feet.

Ventilation in the mine was accomplished by installing "lay-flat" flexible vent bags and using a fan to blow outside ambient air into the mine. In addition, a water management system was constructed to control the release of suspended solids containing heavy metals in the solids precipitated in the mine that became suspended in the discharge flow during entry activities. This did not include treatment to reduce dissolved metals concentration normally present in the acid mine discharge.

Lay-flat vent bag was left intact in the mine adit from the portal to 200 feet inby. After drying and performing appropriate analysis, the spent filter bags, containing an estimated 5 to 7 tons of mine drainage filtrate including those stored at the site since 2011, were transported to the Bondad Landfill in Durango, Colorado, for disposal in July 2012. Following the entry in June 2012, it was determined that additional water management capacity was necessary to control the discharge of the yellow-boy/metals precipitates.

Water sampling was performed during the mine entry efforts while the mine water filtering was

active. The analyses were run to determine if total metals concentrations were controlled during the activities in the mine. Sample results showed that the filter bag system was effective in preventing the release of the solids suspended and preventing an increase in total metals load in the adit flow. Samples collected from the Animas River below Silverton during entry activity showed that water quality was not impacted.

Subsequent to the entry in June, the owner of the adjacent claim agreed to allow access to construct a settling pond to assist in capturing the solids in the discharge water. (Previously, access to do this was not granted for this purpose.) Prior to constructing the pond, the area was evaluated and found to have mill tailings on the ground surface with elevated metals. A stamp mill did operate at the mine and evidence of that operation exists on site. Samples from surface and depth showed metals present including iron at 437,000 to 444,000 mg/kg, lead at 1,500 to 1,800 mg/kg, zinc at 1,200 to 1,500 mg/kg and mercury was detected in the surface sample. The analytical results for the soil are similar to the metals concentrations found in the solids filtered from the water during the during the mine entry. In addition, test pits were dug to determine the depth to groundwater and identify any hydraulic confining layer, and to assess wetland properties. In October 2012, a settling pond was constructed within a mining impacted area (on the Success Placer claim) on the west side of the county road. Ground water was not encountered and the ferricrete layer below the soil was not penetrated. The top, inside dimensions of the pond are approximately 80 feet by 40 feet by 6 feet deep. Additional bank stabilizing work will be performed prior to diverting the discharge flow through the pond for solids collection during the entry work planned for 2013.

Additional assessment is being performed to evaluate sources of metals loading to the watershed on a broader scale. This includes a screening level risk assessment, and contaminant loading modeling involving the USGS. This is being conducted to assist with focusing potential source control options being considered for future actions.

## **2.2 Previous Assessment Activities**

In an effort to characterize the hazardous substance releases in the watershed, the surface water and mine adit discharges were sampled by EPA (remedial site assessment) several times during the year over several years. It is now sampled two times each year (spring and fall) at established locations for water quality parameters, flow volume, and total and dissolved metals in Cement Creek and the Animas River by the EPA Environmental Services Assistance Team (ESAT).



ESAT also performs laboratory analysis and data reporting to the SCRIBE network. This information and other data are being used to develop a Screening Level Risk Assessment, and following that a Baseline Risk Assessment is expected to be produced.

### **2.3 Anticipated Activities**

In 2013, another entry into the mine will be performed to complete the hydro-geologic analysis of the mine-workings, and to complete a bulkhead feasibility analysis. This will be necessary to evaluate potential hydraulic control options within the Red and Bonita Mine adit to stem the flow of metals-laden mine drainage into the Animas River basin. The water management system to be operated during the mine entry will be designed during the winter. Installation of the temporary system will occur prior to entry anticipated for July 2013. Based on the activities in 2012, it is estimated that the entry work may require two weeks to completed including the set up time for the water management system.

### **2.4 Issues**

The limited access to areas needed to expand water treatment capacity for future underground work presents additional challenges to the operation.

### **2.5 Community Involvement**

The Animas River Stakeholders Group is actively involved with the work in the watershed and is routinely briefed on the work at the Red and Bonita Mine. The group was formed to improve water quality and habitats in the Animas River through a collaborative process designed to encourage participation from all interested parties. Participants include mining companies, citizens, environmental organizations, land owners, local governmental entities, and state and federal regulatory and land management agencies. Regular meetings are held with the participants.

## **3.0 RESOURCES ON SITE**

The following is a partial list of organizations that participated in performing work at the site for these activities:

Environmental Protection Agency:

State of Colorado Division of Reclamation, Mining, and Safety (DRMS)

Bureau of Land Management

EPA Superfund Technical Assessment and Response Team (START)

Frontier Environmental Services Company (FES)

EPA Environmental Services Assistance Team (ESAT)

EPA Emergency and Rapid Response Services (ERRS) Contractor

#### **4.0     ADDITIONAL SOURCES INFORMATION**

Animas River Stakeholder Group website: <http://www.animasriverstakeholdersgroup.org/>

EPA OSC website: [http://www.epaosc.org/site/region\\_list.aspx?region=8](http://www.epaosc.org/site/region_list.aspx?region=8)